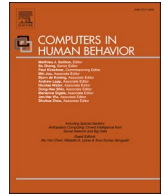




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Community-oriented Motivational Interviewing (MI): A novel framework extending MI to address COVID-19 vaccine misinformation in online social media platforms

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ABSTRACT

Researchers have linked circulating misinformation in online platforms to low COVID-19 vaccine uptake. Two disparate literatures provide relevant initial guidance to address the problem. Motivational Interviewing (MI) effectively reduces vaccine hesitancy in clinical environments; meanwhile, social scientists note inoculation, rebuttal, and appeals to accuracy are persuasive in digital contexts. A tension is inherent in these approaches. MI in digital forums may induce an 'illusory truth effect,' wherein falsehoods appear more accurate through repetition. Yet, rebutting misinformation directly may elicit backfire or reactance effects, motivating some to amplify their presentation of misinformation. Building on Identity Process Theory, we propose a theoretical framework for conducting MI-based infodemiology interventions among digital communities that conceptualizes the community in toto (rather than one specific person) as the unit of focus. Case examples from interventions on public Facebook posts illustrate three processes unique to such interventions: 1) Navigating tension between addressing commenters and "bystanders"; 2) Activating pro-vaccine bystanders; and 3) Reframing uncertainty or information individuals might find concerning or threatening according to implied collective values. This paper suggests community-oriented MI can maximize persuasive effects on bystanders while minimizing potential reactance from those with committed beliefs, thereby guiding community-oriented public health messaging interventions enacted in digital environments.

1. Introduction

COVID-19 vaccination is a critical component of the US public health campaign to address the impact of the SARS-COV-2 virus. While alternative treatments to vaccination are available (e.g., corticosteroids, monoclonal antibodies, remdesivir, tocilizumab (Nhean et al., 2021), nirmatrelvir-ritonavir (aka Paxlovid) or molnupiravir (Saravolatz et al., 2022)), vaccination continues to substantially reduce the risk of serious chronic illness, infection, hospitalization, and mortality (Mohammed et al., 2022; UKHSA COVID-19 Evidence Team, 2022). Estimates range from 234,000 (Amin et al., 2022) to 318,000 (Brown University &

Microsoft AI Health, 2022) deaths in the US could have been prevented through higher vaccination rates.

Rates of vaccination rose rapidly in the first half of 2021 after they became widely available. Unfortunately, vaccination progress at the population level has slowed dramatically in more recent months (Johns Hopkins Coronavirus Resource Center, 2022). As of August 2022, approximately two thirds of people in the US have received at least one dose of the COVID-19 vaccine. Rates vary widely by state, with approximately 50% vaccinated in Wyoming to nearly 85% in Rhode Island.

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1.1. Medical misinformation and social media: implications for COVID-19 vaccination motivation

There is increasing evidence that exposure to false or inaccurate information and the misrepresentation of legitimate health research is specifically associated with reduced COVID-19 vaccination rates (Loomba et al., 2021; Neely et al., 2022). The distribution of misinformation is particularly problematic in internet-enabled communication platforms (e.g., “social media,” peer-to-peer encrypted messaging, etc.). Information consumers have morphed into information producers, allowing information and misinformation to propagate rapidly through horizontal, decentralized networks (Kümpel, 2021; Young & Miller, 2021). The more incorrect information is repeated and the longer it is allowed to persist without challenge, the more likely it is to influence actual health behaviors, a phenomenon termed the “illusory truth effect” (Brashier et al., 2021; Walter & Tukachinsky, 2020). Encountering inaccurate information can be confusing and lead to hesitation or doubt even in those with robust prior knowledge (Rapp & Salovich, 2018).

The consequences of online misinformation have been particularly evident during the COVID-19 pandemic. Even after the WHO’s pandemic declaration, US residents relied more on social media for health-related information than on health authorities like the US Centers for Disease Control and Prevention (CDC) (Neely, Eldredge, & Sanders, 2021). Belief in COVID-19-related misinformation and conspiracies has been linked to erroneous beliefs about the virus itself (e.g., risk of infection or modality of transmission), the effectiveness of behavioral risk mitigation (e.g., masks or social distancing), as well as the safety and efficacy of COVID-19 vaccines (Hornik et al., 2021; Neely et al., 2022; Romer & Jamieson, 2020; 2021; van Mulukom et al., 2022).

The effect of misinformation propagated through social media cannot be adequately countered by traditional health information campaigns. Accurate information is insufficient to counteract codified false beliefs and attitudes (Roozenbeek & van der Linden, 2022; van der Linden, 2022; Walter & Murphy, 2018), especially when those beliefs are intertwined with someone’s identity (Kahan, 2017b). Existing research has tested a range of intervention techniques designed to influence opinion in online spaces, including: inoculation (van der Linden, 2022), warnings/labels (Morrow et al., 2022), and promoting critical thinking or media literacy (Ecker et al., 2022), as well as debunking, refuting or rebutting misinformation (Chan, Jones, Hall Jamieson, & Albarracín, 2017; Walter & Murphy, 2018). However, the effect sizes of successful online interventions are often modest and rapidly decay (Maertens et al., 2021; Mourali & Drake, 2022). A full review of this literature is outside the scope of this paper; see Scales et al., 2021 or Ecker et al., 2022 for more details.

1.2. Motivational interviewing and the potential to develop online, social-media delivered intervention strategies to address medical misinformation and increase COVID-19 vaccination uptake

Motivational interviewing (MI) is a “directive, client-centered counseling style for working collaboratively with clients to enact a behavior change” (Magill & Hallgren, 2019). The principles of MI were inductively established through treating patients with substance use disorder by clinical psychologists William Miller and Stephen Rollnick in the 1980s (Miller & Rollnick, 2012). While scholars continue to debate the mechanism by which MI appears to be effective (Magill & Hallgren, 2019), it has a decades-long track-record of success in facilitating change across a wide spectrum of health behaviors (Lundahl et al., 2013; Palacio et al., 2016; Smedslund et al., 2011). Of particular relevance, studies indicate MI-based interventions increased the likelihood that parents would consent to vaccinate their children (Gagneur et al., 2018, 2019; Lemaitre et al., 2019) and have shown promise to promote uptake of vaccines against human papilloma virus (Brewer et al., 2020; O’Leary et al., 2017; Reno et al., 2018, 2019). Unlike psychoeducational strategies, MI is “a collaborative conversational style for strengthening a

person’s own motivation for and commitment to change” (Miller & Rollnick, 2012, p. 12). In the context of a working alliance characterized by empathy, curiosity, and compassion, the MI provider uses a core set of counseling skills (open questions, affirmations, reflections, and summary statements) to engage individuals, arrive at a shared goal or focus for the interaction, evoke motivation for change, and, if appropriate, create plans for accomplishing identified goals.

Three specific aspects of MI suggest an adapted intervention might be effectively deployed in an online context to enhance motivation for health-related behavior change, countering medical misinformation in general, and increasing vaccine confidence, particularly for COVID-19 vaccines, even when simultaneously faced with misinformation presented by online commenters. First, MI was developed to address ambivalence and explore and amplify personal motivation especially in those not necessarily aware of nor interested in the need for change. Online environments, replete with “echo chambers” and “epistemic bubbles” (Nguyen, 2020), are populated by commenters with particular beliefs influenced by medical misinformation, including those who are prejudiced against vaccination and equipped with arguments against it characterized by misleading information and falsehoods. It is precisely this population that is considered particularly challenging to persuade, yet MI provides a starting point to develop principles for engaging such commenters productively. Second, eliciting someone’s perspective on a target behavior and how they might go about change is a central component of MI. Third, the concept of supporting personal autonomy (i.e. the right to self-determination) and enhancing self-efficacy (i.e., someone’s belief in their own capacity to enact behavior change) by drawing out and acknowledging an individual’s strengths and resilience is central to MI. Critically, self-efficacy has also been shown to be an important element in counteracting misinformation (Seo et al., 2021).

As MI was initially developed as an individual intervention, it received critique for insufficiently factoring in social context (Stanton, 2010). It has since been adapted to cultural contexts that exhibit more collectivist and less individualistic cultural values (Self et al., 2022) and extended for use with counseling groups (Velasquez et al., 2006; Wagner et al., 2012) and couples (Starks et al., 2018, 2020, 2022). In each of these instances, the expansion of MI was facilitated by the integration of theoretical concepts that informed counselors’ capacity to respond to contextual factors. Self et al. (2022) reviewed several studies each incorporating values, customs, and traditions reflecting cultural uniqueness to achieve higher values alignment and greater MI efficacy. Velasquez et al. (2006) drew upon theories of group process to balance the need to emphasize group cohesiveness and homogeneity amidst the MI process of drawing out individual heterogeneity. Starks (2022) drew upon interdependence theory to position individual decision making in the context of relationship functioning and the formation of joint goals shared by both partners in a couple.

Unfortunately, these existing innovations in MI practice with more than one person are not fully equipped to directly assess COVID-19 vaccination in an online, social-media setting. There, stakeholders are diverse with respect to their beliefs and activity level (whether they comment spontaneously, only in response to others, or merely observe) as well as their attitude towards the health behavior (e.g., COVID-19 vaccination). The person delivering an MI intervention has little or no control over the composition of the stakeholders in attendance and must deliver or engage in the intervention in a manner visible to the group at large. In short, a community-oriented framework for the delivery of MI is needed to facilitate implementation in online spaces.

1.3. Conceptualizing the challenges to implementing MI in social media spaces: the composition of stakeholders in online forums

In their work on group-based MI, Wagner et al. (2012) specifically discussed the influence of the counselor on group composition. In some instances, groups are selected to be homogenous with respect to readiness for behavior change. In others, group members may be selected so

that those who have achieved some degree of behavior change may serve as peer models of potential change for those who might be in the initial stages of consideration. Unfortunately, interventionists in online social media spaces are unable to exercise control over the composition of stakeholders active in that space. They therefore need a theoretical framework that can inform practice strategies in the absence of such control.

Stakeholders in online forums may vary in the frequency with which they post comments, yet those who comment actively often have the most committed beliefs (Duggan & Smith, 2016). Their opinions and behaviors are also the most difficult to impact (Kahan, 2017a). As a result, those exerting the greatest influence on dialogue in online forums may represent the group least-responsive to intervention. Others, referred to as “bystanders,” may observe in these forums but may be reticent to participate. Previous research on hate speech and cyberbullying has examined “cyberbystanders” or “bystanders,” defined in that literature as those who witness anti-normative behavior but are reluctant to intervene (Wang, 2021). We identify two forms of ‘bystanders’: silent observers (passive bystanders) and those who join the conversation (active bystanders). Active bystanders differ from original posters or commenters in that they post only in reaction to comments made by others (whereas original posters and commenters post spontaneously and intentionally initiate exchanges). To maximize impact and minimize psychological reactance (i.e., a backfire effect), communication interventions in online spaces need strategies that can speak to and engage all community stakeholders—original posters, commenters, and bystanders—simultaneously.

Best Practice Guidance from the World Health Organization explicitly suggests addressing vocal anti-vaccine personalities in public by focusing on bystanders rather than those with committed beliefs (WHO-Europe, 2019). While intuitively appealing (since they are the most likely to be receptive to a behavior-change intervention), delivering an intervention in heterogeneous online forums tailored solely to address bystanders is challenging and may have unintended consequences. Interventionist utterances that correct, refute or challenge misinformation may be effective in shaping the attitudes, beliefs, and behaviors of less psychologically committed bystanders (Chan, Jones, Hall Jamieson, & Albarracín, 2017; Walter et al., 2021; Walter & Murphy, 2018). Unfortunately, such utterances may also precipitate psychological reactance from those more committed to their position (Byrne & Hart, 2009). This may motivate them to amplify arguments that favor their position – potentially eliciting the repetition of posts containing misinformation rather than diminishing its presence and influence. A field experiment from at least one popular social media platform illustrates this concern as posters who were corrected subsequently exhibited more extreme behavior (Mosleh, Pennycook, & Rand, 2021).

1.4. Identity process theory and the expansion of motivational interviewing to community contexts

The question of how individuals interact with a collective—how group membership or participation influences individual behavior—has been discussed extensively within theories of identity development. Prominent among these is Identity Process Theory (IPT) which has a demonstrated track record of applications to health behavior. It provides a framework for understanding the implications of group membership on the valuation of information. IPT suggests that identity emerges from two processes: how people absorb and adopt new information into their identity (called assimilation-accommodation) and how they attach meaning and value to that information (evaluation). Identity principles like self-esteem, self-efficacy, distinctiveness, continuity and coherence guide these two processes. Theorists describe an identity as “threatened” when an identity process is not commensurate with identity principles and suggest that people engage in coping strategies to mitigate the subsequent discomfort. Some coping strategies can be understood as

maladaptive (e.g., denial or concealment) in that they reduce identity threat by avoiding the processing of information that threatens one’s identity. In contrast, adaptive coping strategies limit identity threat either through creating new collective norms (via group mobilization) or assimilating the new information (and consequently modifying one’s identity to reduce conflict) (Jaspal & Breakwell, 2014).

Identity process theory has been applied to understand COVID-19 prevention behaviors (Jaspal & Nerlich, 2020). It has also been used to conceptualize how health risks are processed with reference to whether they affirm or conflict with one’s identity (Breakwell & Jaspal et al., 2022). While it may initially seem irrational to voluntarily incur greater risk of severe outcomes from COVID-19, identity process theory would suggest that motivation to do so might arise from social representations of vaccination that have taken on political and identity-related connotations. In short, for some individuals the act of vaccinating would represent a violation of the behavioral norms that embody or exemplify membership in a social group that is central to their identity. In this circumstance, the individual may evaluate the social costs associated with vaccination as outweighing its potential health benefits. Tension between a personal health behavior and a salient social identity would also be expected to increase receptivity to misinformation that affirms the social identity or discounting of accurate information that promotes behavior incongruent with social identity. Empirical evidence supports the idea that individuals selectively incorporate or discount risks in ways that support their cultural identities (Kahan et al., 2007).

IPT would suggest that any framework for community-oriented MI (COMI) to address COVID-19 vaccination needs to incorporate the potential for perceived identity threats to activate cognitive dissonance and ambivalence. The theory suggests personal and social identities are juxtaposed, integrated, and context-dependent (Breakwell, 2014). So, the role of the interventionist can be understood, in part, as facilitating acquisition/accommodation and evaluation to promote more community-oriented adaptive responses. Put another way, to mitigate conflict, an interventionist needs to actively soften the implications of health behavior for group identity. This may be done by identifying ways in which the health behavior can be viewed as congruent with, or incorporated into, in-group membership, and activate group norms and values that might increase positive evaluation of the health behavior.

1.5. Identity salience and behavioral ambivalence

There is a small but substantive body of existing evidence consistent with the general premise that reframing behavior in terms of group-based values has an impact on motivation. For example, conservatives become more supportive of environmental legislation when framed in terms of traditional conservative priorities of purity and sanctity (Feinberg & Willer, 2013). Similarly, framing mask wearing (to reduce COVID-19 transmission) in terms of loyalty and appealing to protecting America as a community increased uptake of masking among American conservatives (Kaplan et al., 2021). Despite this promising evidence, interventions that capitalize on group-based values to enhance personal health motivation are underutilized (Feinberg & Willer, 2019).

Activating personal values is a common technique in MI (Bean et al., 2015). The interviewer’s goal is to develop discrepancies between an individual’s broader goals values and a behavior targeted for change. The implication of IPT is that group-based values might be leveraged in comparable ways. The integration of such strategies into COMI might be particularly effective given that they have the potential to appeal to aspects of identity that are relevant for highly-committed people who may comment actively on social media and they are also unlikely to elicit backfire effects – or activate sustain talk – from bystanders in these settings (Feinberg & Willer, 2019).

Research on identity-related information processing also implies that stakeholder perceptions of whether or not the infodemiologist delivering COMI is an in-group or out-group member will influence

receptivity to the intervention. According to social identity theory (Tajfel & Turner, 2004) and the self-categorization sub-theory (Abrams et al., 1990; Turner, 2010), people are more likely to discount information delivered by out-group messengers because the messenger themselves or their perceived membership in other out-groups sends a signal about whether the information they deliver is likely to affirm or deviate from group norms. Therefore, the identity implications of the information received and the message receiver's perception of the messenger delivering it are both likely important factors at play in online interactions.

1.6. Purpose of the current study

While in principle IPT has the potential to inform the application of MI in online social media spaces, no attempt has previously been made. The goal of this proof-of-concept study was to evaluate the viability and utility of a COMI framework that integrates concepts from IPT to understand stakeholder responses and guide infodemiology interventions designed to address medical misinformation online, using COVID-19 vaccine hesitancy as a case study. We hypothesized that qualitative examination of discussion thread transcripts would yield exemplars of processes unique to the delivery of COMI. These would then serve as a starting point for the identification of specific, relevant intervention skills and strategies that might be effective in these settings.

2. Methods

Discussion thread transcripts provided below are taken from interactions on Facebook conducted by infodemiologists between December 2020 and April 2021 with the goal of evaluating the feasibility and acceptability of a prototype intervention protocol developed by DS and JMG. The protocol for intervention included the following steps:

1. We posted on communications job boards to recruit potential infodemiologists, asking about their connection to their local community and their willingness to intervene in an online intervention focused on that geographic area. This ensured the infodemiologists self-identified as part of the communities in which they intervened.
2. After identifying appropriate comment threads as described below, the infodemiologist would begin an "intervention" with a question attempting to elicit further explanation from the poster about their point of view. Initial questions were intended to follow MI-based principles of empathy and non-judgmental curiosity.
3. Immediately afterwards, the infodemiologist posted a transparency statement identifying themselves as a member of the research team with a link to a webpage with more details of the research and procedures for withdrawal.
4. The infodemiologist then attempted to continue the conversation with the primary commenter, balancing as they saw fit the use of evidence-based approaches (Scales et al., 2021) melded with techniques derived from motivational interviewing. The infodemiologists were expected to be respectful and to model appropriate online commenting behavior.
5. Infodemiologists were counseled to consider both the primary commenter and active and passive bystanders observing these online conversations as they crafted their responses.
6. The infodemiologist could introduce corrective information to blunt an "illusory truth effect" while maintaining a respectful and non-judgmental stance.
7. As part of data recording, infodemiologists reflected in writing on the exchange in our data collection platform. Infodemiologists and researchers then also discussed these reflections and challenges at weekly virtual meetings throughout the course of the study. These group supervision sessions involved discussion of intervention work and review of session transcripts to ensure fidelity to the overall

protocol. Challenges to MI skill implementation were reviewed and ongoing skills training was conducted.

Four infodemiologists selected for their interest in communication underwent a skills-based training consisting of independent reading about infodemiology and addressing misinformation in online contexts (e.g. see citations (Gorman & Gorman, 2021; Scales et al., 2021)), practice interventions, and weekly supervision sessions with either DS or JMG, totaling approximately 20–25 hours, until competency was established. Competency was maintained through the weekly supervision sessions as noted above.

We built a surveillance system leveraging Facebook's native features and followed news sites and monitored news feeds allowing us to identify posts containing media reports originating from three geographic regions, Newark, NJ; Chicago, IL; and central Texas. Infodemiologists selected posts with comments containing either misinformation about vaccines or encouraging an anti-vaccine stance. We defined misinformation about COVID-19 vaccines as any post that contained incorrect material about vaccines in general or COVID-19 vaccines specifically, regardless of the motive of the person posting the misinformation. This included factually-incorrect statements (e.g. "the vaccines are killing people") and true statements expressing uncertainty about the vaccines (e.g. "we don't know the long-term side effects"). To avoid online harassment, infodemiologists avoided highly contentious or overtly partisan posts. Infodemiologists aimed to respond as soon as possible after the original posting, at least within several hours, to maximize engagement. This research was judged as exempt from review by the Ethical and Independent Services review board and was approved by the IRB of the Weill Cornell Medicine.

De-identified comments were collected by the infodemiologist at the time of the intervention along with URLs, infodemiologist reflections, and native engagement metrics (e.g. likes, shares) and recorded in a password-protected database. A conversation would be considered stale after a maximum of five days, with final engagement metrics updated at that point if necessary.

Note that all transcriptions reported here have been paraphrased to protect the identity of commentators from subsequent identification through search engine queries (Townsend & Wallace, 2016). To emphasize the community orientation of interventions and for conceptual clarity, we refer to commenters and bystanders as defined above but use "stakeholder" to identify contributors to the online discussion in the transcripts. Some transcripts were trimmed for brevity.

2.1. Analytic approach

Infodemiologists transcribed exchanges at the time of the intervention. Our initial coding scheme included deductive codes comprised of 12 elements from our intervention protocol (derived from Scales et al., 2021) plus several codes derived inductively. To avoid bias, the creation of the coding scheme and the first round of coding was conducted by a member of the analysis team who had had minimal contact with the infodemiologist team and did not engage in any of the creation of or training on the protocol (PD). Once completed, DS reviewed the coding scheme, also coded, and then both coders discussed their shared impressions to finalize the code book, discursively resolving any coding discrepancies. Through the course of the analysis, DS and PD met frequently to discursively and iteratively engage in analyzing emerging patterns from the transcripts until thematic saturation was reached and a codebook developed using NVivo software. Through the qualitative coding process, big-picture themes emerged inductively from examination of the infodemiologist-commenter-bystander interactions as a whole. Below we use case examples from discussion transcripts to illustrate these themes.

3. Results

Across the 146 transcripts examined, a total of 93 precipitated some type of engagement from commenters or activated bystanders, consisting of reactions (likes or other emotional reactions), comments or both. As transcripts were de-identified, we cannot determine the number of unique users interacting with our posts. Geographically, the origin or focus could be ascertained in 133 posts; 45 posts had a media focus on Texas, 55 on Chicago, and 8 oriented toward Newark. The remaining 25 posts for which geographic focus could be determined were nationally oriented or spread across other states.

We have selected representative examples of more successful interventions that portray our experience with counteracting misinformation online. We found conversations that more closely adhered to motivational interviewing techniques were generally more successful than interventions employing fact-based rebuttals early in the discussion. However, further detailed analysis of these interventions will be provided in forthcoming publications.

Our theoretically guided review of transcripts identified three processes uniquely relevant to the application of COMI addressing misinformation in these digital environments. First, there was an ongoing need to balance attention between focusing on commenters versus bystanders. Second, infodemiologists activated bystanders (eliciting comments from those who were initially passive observers) and then facilitated the integration of those contributions to the online discussion. Third, in efforts to meet community-oriented goals, infodemiologists reframed behavioral uncertainty or seemingly disconcerting information according to implied collective values.

3.1. Tension between focusing on committed believers versus bystanders

Across sessions, infodemiologists were presented with the challenge of deciding whether to formulate a response aimed primarily at commenters with committed beliefs versus considering the impact of rebutting misinformation on bystanders. This first example reveals an infodemiologist's strategy to ensure misinformation does not persist in the forum unrebutted. Here the infodemiologist replies to comments on a Facebook post from a prominent midwestern medical center encouraging people to get the first COVID-19 vaccine available (associated reactions: Like:159, Haha:55, Love:22, Angry:5, Hugs:2, Wow:1, Tears:1; Comments:95, Shares:33).

Stakeholder 1: Won't be surprised to see an ad in many years saying "if you got the covid vax in 2021, you are entitled to compensation." The FDA hasn't approved them. Can't shame people, whether they get the vax or not, it's NOBODY'S business but ours. Do you shame people into getting other vaccines? Be kind and don't impose your views on others.

Infodemiologist: @1 It's certainly your choice to get the vaccine or not and I agree that folks must be respectful. Can you explain more about your vaccine concerns? They were researched in large trials which proved they effectively reduced covid symptoms. This link talks more about FDA's emergency use. [FDA link] [research disclaimer].

Stakeholder 2: @1 Injuries from vaccines with emergency auth aren't compensated.

Infodemiologist: @2 The vaccines have been studied in trials involving thousands of people. The chances of vaccine-related injury are minimal based on the results. If there are injuries, they can be reported to Vaccine Adverse Event Reporting Systems (VAERS). Some folks can get compensated for injuries [HRSA link] These vaccines remain our best hope of ending the pandemic.

Stakeholder 3: NO vaccines have been FDA approved the article is a lie.

Infodemiologist: @3 In emergency situations, the FDA grants emergency authorization but only something's been studied in big clinical trials. Their usage is authorized if the benefits largely outweigh the risks. There's no compromise on vaccine safety. This link might help explain some of the details of EUA vs approval [FDA link].

Stakeholder 3: @Infodemiologist Thanks. There are many contradicting studies so I'm not going to keep debating. Natural therapies that can heal Covid are better, instead of lockdowns, masks, and injecting poisons. Moderna clearly affects DNA and you can't undo that. Sometimes I wish folks like you and me could just sit down face to face and talk about all this. I must say that you have been respectful with your comments and information, and I appreciate that. Have a great holiday! 😊

Consistent with MI principles, the infodemiologist's initial post opens with an affirmation of autonomy and a question that elicits the commenter's perspective. The infodemiologist then pivots to present accurate information about COVID-19 vaccination. Their goal was to prevent or diminish an illusory truth effect by rebutting the factual substance of Stakeholder 1's posting. Unfortunately, this introduction of information appears to threaten a group norm. This elicits a reactance response from Stakeholder 2. An additional rebuttal continues to threaten the group norm and a sympathetic expression of reactance is triggered from Stakeholder 3. In this passage, the infodemiologist opts to disregard the reactance responses from commenters and maintains a primary focus on bystanders. Their information-focus posts are best understood as directed at observers whose attitudes may not be represented by active commenters in the thread and thus less likely to feel their identity threatened by the new information.

In our initial example, the infodemiologist pivoted rapidly to a strategy aimed at bystanders. In this second example, the infodemiologist instead sustains a focus on the commenter. In this thread, a meme was posted on a public, pro-science Facebook group favorably comparing vaccines to homeopathy. Many comments were pro-vaccine; however, one commenter raised a concern that mRNA vaccines were a new and unknown technology (associated reactions: Like:2.1k, Love:228, Haha:51, Hugs:6, Tears:1, Comments 166, Shares 339).

Stakeholder 1: A word of caution: these nucleic acid vaccines are a new technology never used before. So we should all agree that the long-term effects are unknown, especially of follow up shots. Plus, I'd like to see head-to-head comparisons between the vaccines and other Covid-19 treatments like hydroxychloroquine, zinc, or Vitamin D. Without answers how can I truly consent to being vaccinated? After all, Thalidomide was once thought to be safe.

Stakeholder 2: @1 Nope, we can't agree. Please check out the Infodemiologist's response. It's comprehensive.

Stakeholder 3: @1 I have an idea – people should report your response and block you.

Stakeholder 1: Despite what the infodemiologist says, there are plenty of experts who agree that these vaccines are unsafe. I'm an engineer and believe we should be testing all hypotheses. I'm not convinced that these vaccines are safe. Here's just one warning from an expert out of many [YouTube weblink].

Infodemiologist: @1 Thanks for the video. [Expert name] is not a doctor or virologist and doesn't have the most reliable and accurate information about the covid vaccines and he's made a number of claims that turned out to be false. [Link to independent factchecking site].

Stakeholder 1: @Infodemiologist Thank you. Let's see what happens over the next year. What do you think about how [EU country] had a high death toll even though it has the highest percent of vaccinations in the EU?

[Euro News web link] I'm skeptical of [FactChecking website] fact checkers, since they are govt controlled. Also, I must reiterate that [Expert] worked in high positions in lots of organizations even the United Nations.

Infodemiologist: @1 [FactChecking website] is pretty highly rated for credible reporting. Also, while [Expert] held those positions, he wasn't working in any capacity that would make him an expert on vaccines or Covid.

Stakeholder 1: @Infodemiologist I hope you're right, but I worry about the damage to freedoms, livelihoods, covid passports, etc. Where I

live, millions have been thrown out of work. Why?? Don't you see the danger here? To save a few elderly folks like me, and a few with compromised immune systems? I don't want to live in an authoritarian society. Still, I appreciate your thoughtful comments.

Stakeholder 4: @1 You keep changing the question every time you've been debunked. The science doesn't support what you say.

Infodemiologist: @1 I appreciate our chat and do understand your concerns. Please stay safe and well.

Stakeholder 1: @Infodemiologist Last question if you don't mind: are there scientific studies about mask effectiveness out there? Not official statements but real studies. I haven't seen convincing evidence but you may have better info. TIA.

Infodemiologist: @1 Sure, here are a few that might interest you. [medical journal links].

The infodemiologist is actively balancing the need to express empathy and a desire to understand Stakeholder 1's perspective with the simultaneous need to prevent illusory truth effects among bystanders as Stakeholder 1 posts a range of misinformation about COVID-19 vaccines. Several aspects of the infodemiologist's approach are successful here. First, they explicitly assume a non-judgmental stance towards Stakeholder 1 as a person. They actively affirm Stakeholder 1's personal autonomy and self-efficacy for health-related decision making. As a result, the information presented by the infodemiologist is experienced as a rebuttal of Stakeholder 1's information, but not as a personal criticism or judgement leading to identity threat. Instead, in this context, the identity of the group is pro-science, so as Stakeholder 1 elucidates their views, other Stakeholders push back to inform them that their views are not consistent with the group's identity. Stakeholder 1 attempts to frame their concerns as identity-congruent: as legitimate scientific exploration of all hypotheses, or, separately, based on the belief that governments may not be trustworthy sources of information.

Notably, the infodemiologist retains a consistent focus on Stakeholder 1. In contrast, they might have aligned with Stakeholder 2 or 3 (who offer comments which themselves reject Stakeholder 1's initial stance against vaccination). Doing so would run the risk of alienating Stakeholder 1 and implicitly creating the perception that the infodemiologist was allied with Stakeholder 2 and 3 against Stakeholder 1. That expression of implicit judgement and alliance may have altered Stakeholder 1's reaction to information presented by the infodemiologist and might at least partly explain their reactance response. The combination of both the norms of the pro-science group plus the infodemiologist's willingness to take Stakeholder 1's concerns seriously and address them respectfully appear to achieve some assimilation as Stakeholder 1 frames their final question about masks in an identity-congruent way.

3.2. Activating pro-vaccine bystanders and responding to their contributions

Regardless of whether they focused on commenters or bystanders, infodemiologists in the previous transcripts largely adopted a strategy in which they served as the source of accurate information used to rebut the presentation of misinformation and, as may be expected from IPT, stakeholders resist the infodemiologist in the first transcript as the information provided is identity-threatening. This makes the infodemiologist an outsider and a threat, and therefore suggests a rebuttal-oriented strategy is risky. A key feature of the distributed, networked information environment on social media is that information consumers are now also information producers (Kümpel, 2021). The potential for bystanders to serve as the source of effective, corrective, and accurate information is hinted at in the previous examples, particularly the second one. IPT would suggest this strategy would be less likely to activate a cohesive group-level reactance response.

The following passage came from a Texas local radio news post on Facebook explaining how readers could obtain their second dose of the COVID-19 vaccine. Here, the infodemiologist provided information

dispassionately and linked it with sources likely to be trusted by all stakeholders. When the original commenter ultimately responds with a link from Children's Health Defense, an organization often found to be one of the worst spreaders of anti-vaccine misinformation (Yang et al., 2021), the infodemiologist provides a fact-based rebuttal with a reminder that source integrity is of high importance.

Stakeholder 1: Don't do it [get the COVID-19 vaccine].

Infodemiologist: @1 Lots of people are worried about new technology, is there anything specific you're worried about?

Stakeholder 1: @Infodemiologist the vaccines don't stop the virus from spreading. They're not even FDA approved and who knows what the long term side effects are. The media aren't telling the truth about deaths from the vaccine and all the problems it's causing. Tell the truth – it'll come out sooner or later once those trying to tell the truth stop getting censored.

Stakeholder 2: @1 right on.

Stakeholder 3: @1 where's your classified source with all the "truth" you claim? [bespectacled, smiling face emoji].

Infodemiologist: @1 The vaccines reduce symptoms, severity of disease and the chances of getting sick, and they're shown to cut the number of deaths. The emergency authorization process is very thorough with thousands of participants.

A new vaccine can seem nerve-racking, but there's no reason to assume there will be long-term side effects – Covid causes worse long-term effects anyway.

Stakeholder 1: @3 What sources do you have to prove the vaccines protect you? If you do your research you'll see IT IS NOT APPROVED BY THE FDA AND YOU CANNOT SUE IF YOU GET HURT. That's got to raise red flags.

Stakeholder 1: @Infodemiologist no it wasn't according to the news.

Stakeholder 3: @1 the liability clause is literally the same for every vaccine. Are you antivax? Do you doubt all vaccines? Why does this one bother you so much?

Stakeholder 1: @3 nope.

Infodemiologist: @1 This info was really helpful for me to understand why the Covid vaccines are effective [Link to medical center info website].

The original comment in this thread lacks detail. It expresses what can be interpreted as an anti-vaccine message. The infodemiologist's intervention draws out more information from Stakeholder 1, which activates two bystanders (Stakeholders 2 and 3). Stakeholder 3 continues to participate with posts that favor COVID-19 vaccination. Stakeholder 3 might be understood as a bystander whose participation was activated by the infodemiologist's intervention.

Unfortunately, while bystanders may be in possession of accurate information, their comments in online spaces may be counterproductive when they are framed in ways that are perceived as identity threat. Many pro-vaccine bystanders created highly confrontational posts when they chose to comment, such as by belittling the primary commenter or vaccine-hesitant bystanders for violating implied group values. The infodemiologist capitalizes on Stakeholder 3's posting in two ways. First, they use it as an opportunity to offer accurate information by reframing the pro-vaccine arguments or offering a web link to a source likely to be trusted by the commenter and thus less identity threatening. Second, they explicitly empathize with those who may not yet be vaccinated and express support for autonomy. Such empathy implies that Stakeholder 1's views are identity congruent, thus serving not only to reassure them but also reduce reactance based on any perceived identity threat. Broadly speaking, the infodemiologist's tone and comments seek to enhance receptivity to the information presented and diminish the risk this information, or Stakeholder 3's posts generally, elicits reactance from commenters committed to an anti-vaccine position.

3.3. Reframing disconcerting information or uncertainty according to collective values

In the example below, the infodemiologist responds to an article posted by a commenter on Facebook. The posted article is from a local news source and describes a recently published scientific study that found Covid-19 vaccines highly effective. The infodemiologist's initial post is consistent with a rebuttal strategy and presents alternative sources of accurate information. The infodemiologist's second post represents a strategy that appeals to collective values and group norms. Notice that the post is framed in the plural "Many of us ..." and implies a collective (rather than a strictly personal) experience or attitude.

Stakeholder 1: Same government source who won't acknowledge all these vaccine side effects, like miscarriage or dying.

Stakeholder 2: @1 I know, right !?!? Can you imagine

Stakeholder 3: @1 what, you worried about having a miscarriage?

Stakeholder 1: @3 enjoy being a guinea pig.

Stakeholder 4: [GIF of man in tin foil hat with caption "Seems a little crazy!"]

Infodemiologist: There have been no deaths or miscarriages officially linked to the vaccine. But how many deaths are due to COVID-19? Over 550,000 deaths in the states alone. We also know pregnant women are high risk for serious illness from COVID. I trust my doctor and look to sources like [COVID experts] to learn more: [web link].

It's easy for sensational posts on social media to frighten us, but it's clear the risks of COVID far outweigh the risks of the vaccine.

Stakeholder 1: @Infodemiologist you really believe that covid directly has caused 550k deaths or you just quoting official stats. Lol. Open your eyes.

Infodemiologist: @1 When I open my eyes, I see so many people suffering during this pandemic. Many of us, myself included, have had loved ones pass away. People who have survived COVID still experience painful symptoms months later. I see a devastating virus that has taken so much from our communities. And I see a vaccine that can protect people and get us back to normal lives.

Stakeholder 5: @1 Aren't all vaccines like that though? Like the ones we give our kids for school?

Stakeholder 6: @5 those vaccines have years of research behind them and are FDA approved, these only have emergency use ... the folks getting the vaccine are the experiment.

Stakeholder 5: @6 I hear ya. Still, pointing out the govt. won't take responsibility for any side effects is a scare tactic. There are tons of vaccines but the gvt has never taken responsibility for any of them.

Perhaps the most notable impact of the infodemiologist's appeal to collective values is the activation of Stakeholder 5. The infodemiologist sent the message that people who see vaccination as a way to meaningfully alleviate individual suffering may not be alone. That message is then embodied in the participation of Stakeholder 5, who appears to take a pro-vaccine stance. Together, these facets of the exchange may send a message to other (passive) bystanders that there is a community of people whose values, beliefs, and attitudes align with vaccine uptake. This is an example of catalyzing what Identity Process Theory would understand as incorporating a particular health behavior into group norms.

In this particular example, the infodemiologist's appeal to collective values also represented a shift to focus on bystanders rather than the individual Stakeholder 1. While effective in this particular context, Identity Process Theory would suggest that appeals to collective values and incorporating the health behavior into group norms may engage individual commenters as well as bystanders. Stakeholder 1 is concerned about the health of others. This concern may very well be shared by others present in this online space. Consider the following hypothetical alternative response.

Stakeholder 1: @Infodemiologist you are certain that covid directly has caused 550k deaths or you quoting cdc statistics. Lol. Open your eyes.

Infodemiologist: @Stakeholder 1 I suspect that lots of us here care a great deal about staying healthy – regardless of the exact number of people who have died from COVID-19. If we discount information from sources like Dear Pandemic (that are reporting information from CDC and FDA) then who should we listen to?

The infodemiologist's post in this hypothetical example appeals to collective values while also inviting Stakeholder 1 to share more about their perspective. The post simultaneously allows Stakeholder 1 to reflect on whether they can identify viable alternative information sources and also may catalyze everyone present (bystanders and commenters) to weigh the merits of any alternative information sources against those offered by the infodemiologist.

4. Discussion

The framework presented here provides four key insights into how infodemiologists can address misinformation in online forums. First, in a shift from individual-, dyadic-, or group-focused MI interventions, COMI re-positions the community as a whole as the client. Second, consistent with Identity Process Theory, community-level resources such as collective efficacy or incorporating health behaviors within group norms may be leveraged as sources of behavioral motivation. Third, novel but essential provider strategies for accommodation/assimilation and evaluation serve to manage conflict among community members by reframing comments elicited from active bystanders in ways that reduce perceived identity threat and thereby the likelihood of reactance. Fourth, activating bystanders presents an opportunity to leverage the structure of online social media networks to propagate high-quality information delivered by in-group members that identity process theory suggests may increase receptivity. Each of these insights will be discussed in more detail below.

COMI permits a re-imagining of the of community – the group of individuals that comprises those present in an online forum – as the object of intervention. This has three significant implications. First, it expands the universe of strategies available to infodemiologists. They can then move flexibly along a continuum of focus – interspersing utterances that address committed believers with utterances that address the "moveable middle." Second, this approach also yields the novel possibility of utterances that speak to both groups – the committed and undecided – simultaneously. It reorients the concept of "the client" from an individual to community stakeholders. Third, it also changes the goal of interventions from persuading any single individual to modify their behavior to ensuring a healthy digital information environment with in-group members delivering high-quality information to better inform their community and motivate health-related behaviors. In the process, COMI can help a community recapitulate group norms by understanding how a particular health behavior fits within them.

Second, envisioning the "community as client" in an MI intervention implies that community level resources can and should be leveraged to promote individual behavior change. Individual MI leverages the exploring of discrepancies between that individual's behavior and their broader goals and values to generate motivation for change. Culturally-adapted MI has brought aspects of community values and goals to bear on facilitating individual behavior change (Self et al., 2022). Likewise, according to IPT, it may be possible to enhance motivation for change by reframing new or threatening information in ways that align it with group identity. By identifying ways in which information or the health behavior is congruent with in-group norms and values, a practitioner can facilitate the processes of acquisition/accommodation and evaluation to promote positive community-oriented adaptive responses.

Additionally, practitioners will likely need skills reinforcing and promoting identity motives identified by IPT, like self-esteem, distinctiveness, continuity, belonging and self-efficacy. IPT and MI align along a number of these principles and can likely be leveraged to precipitate cognitive dissonance and, ultimately, behavior change. For example, individual MI has viewed supporting self-efficacy – cultivating an

individual's belief in their own capacity to enact change – as a mechanism that increases motivation. This aligns with IPT because self-efficacy is seen as a key motive central to a number of identities, and, in theory, identity threat can be mitigated through reinforcing self-efficacy.

Leveraging community-level resources like group norms and collective self-efficacy brings novel challenges for the COMI provider. Affirmations and reflections that reinforce identity motives like expressing community-level strengths (e.g. self-esteem) and finding common ground (i.e. continuity) become potentially relevant to mitigating perceived identity threats. These utterances provide a mechanism to actively convey a community perspective in the same way that individual level affirmations and reflections have long served as active listening skills for engaging with individuals in MI. Research exploring utterances directed at the social space of a digital community and the information environment in which that community is situated is urgently needed. For example, the concept of collective self-efficacy – an individual's belief in their community's potential to respond effectively to a health threat – has been identified as a predictor of individual health behavior – including COVID-19 vaccination (Gupta, Dellucci, Stewart, & Starks, 2021). However, both IPT and MI conceptualize self-efficacy as embedded within an individual, so research will be needed on how to effectively incorporate utterances that leverage collective self-efficacy into COMI.

In addition, defining and bounding communities in online spaces is not straightforward (Longoria et al., 2021; Stanford Internet Observatory, 2022). One implication is that there may be advantages to peer-based models of infodemiologist delivered interventions as Identity Process Theory suggests messages delivered by in-group messengers will be perceived as less threatening. Infodemiologists address online groups of which they perceive themselves to be a member, situating them to best identify relevant collective values and group norms, reference them with authenticity, and capitalize on content elicited by their mention. As such, infodemiologists can provide information when necessary according to any number of evidence-based strategies, like framing messages (Jordan et al., 2021), strategically leveraging emotion or humor (Yeo & McKasy, 2021), or employing therapeutic communication (Ritter et al., 2021) with additional strategies described by (Scales et al., 2021). However, they have a rhetorical advantage in being able to authentically leverage in-group vernacular and linguistic register to maximize the effect of these strategies.

Third, extending MI to online community stakeholders requires infodemiologists to be equipped with an array of strategies to manage conflict in these settings. One potential source of conflict is reactance or backfire, where rebutting misinformation may unintentionally motivate some commenters who hold views opposing a health behavior to amplify their argument. Exacerbating conflict in online forums is likely an impediment to thoughtful consideration of beliefs and behavior change. Work from MI adapted for couples and group settings offers some insights into how infodemiologists can approach conflict (Starks et al., 2020; Wagner et al., 2012). These include strategies such as slowing the discussion down, active listening, and affirmations. Infodemiologists demonstrated several conflict-mitigation techniques including reframing, avoiding emotional escalation, and using language that demonstrated active listening. IPT would also suggest a strategy of reframing information initially perceived as identity threatening as identity congruent as a way to minimize reactance (Jaspal & Breakwell, 2014). However, future research will provide a more detailed assessment of infodemiologists' strategies to mitigate conflict.

A second source of conflict is disagreement among stakeholders present in the online forum. Literature on cyberbullying has demonstrated that activated bystanders can mitigate negative effects on victims, terminate a bullying episode, and motivate others to also challenge the bully (Anderson et al., 2014; Salmivalli, 2010). Similarly, our work here suggests bystanders can be activated and similarly leveraged to challenge misinformation. The danger is that bystanders may frame

comments in ways that disrupt or disturb the perception of group cohesion or the uniform acceptance of perceived group norms thus exacerbating discord with other stakeholders and eliciting reactance from them. Providers need a set of skills that prepare them to reframe comments from pro-vaccine bystanders in ways that de-emphasizes threats to identity motivations while facilitating acquisition/accommodation and evaluation to promote more community-oriented adaptive responses that minimize conflict or reactance. Again, the existing literature on couples and group applications of MI noted above provide some starting points on how to adapt MI strategies like minimizing conflict to new contexts (Starks, 2022; Starks et al., 2022; Wagner et al., 2012).

Fourth, activating bystanders offers a unique opportunity to leverage the structure of social media to propagate high-quality information beyond the individual thread and infodemiologist. Misinformation is well known to propagate faster than truth (Vosoughi et al., 2018) and does so often because it is more emotionally engaging (Ali et al., 2022). High-quality information on social media can easily be drowned out by other attention-grabbing items like those produced by other users in the online network (Kümpel, 2021; Young & Miller, 2021). However, due to lack of data access, researchers have little insight into how stakeholder behavior changes after online field experiments (Mosleh, Pennycook, & Rand, 2021), with one field experiment demonstrating backfire effects after corrections (Mosleh, Martel, et al., 2021). Since this work suggests that infodemiologists can activate bystanders to productively participate in online forums it raises the possibility of testing IPT-consistent ways of activating bystanders, i.e. by helping solidify their perception that a health behavior aligns with their identity such that they subsequently amplify high-quality information across the network to maximize reach while minimizing psychological reactance.

This study has several limitations. First, we limited our initial, pilot work to three geographical areas (Chicago, Newark, and central Texas), one health-related area (COVID-19 vaccines), and three months of data collection. Additionally, we limited this study to public posts on one social media platform, Facebook, which has clear idiosyncrasies and data collection limitations that markedly limit quantitative analysis of our conversation threads. We also did not objectively assess infodemiologist competency or fidelity to our protocol but relied on weekly supervisions. As this is a pilot, formative study seeking to establish a broad theoretical framework, we are not assessing the degree to which our interventions had impact or were effective in this report. We will address these issues in a future communication.

In summary, our work addressing COVID-19 vaccine hesitancy demonstrates an opportunity to extend MI to community stakeholders. The principles we have uncovered in this work are not limited to COVID-19 vaccines or even vaccines in general but may apply more broadly to other online communities in which medical misinformation proliferates. This work is not attempting to improve MI, which has decades of research and honing described elsewhere (Miller & Rollnick, 2013). Instead, we found the theoretical framework of IPT aligns well with MI and implies strategies to guide practitioners' interventions that speak toward collective identity motivations. These intervention strategies revealed that infodemiologists can successfully engage misinformation in a diverse online platform by reformulating the audience not as any particular individual but as the community as a whole. As a result, the infodemiologist may be affecting change in the information environment a community is immersed in, though more data from digital platforms will be required to fully evaluate this potential impact.

Credit author statement

The first two authors conceived of the study and secured funding, together writing the first draft of the manuscript. Authors three through seven were infodemiologists who advanced the theoretical concepts of the paper through weekly reflection sessions over the course of the project and contributed to revisions of the draft manuscript. The

penultimate author provided expert guidance on program evaluation and input on manuscript drafting. The last author helped shape the paper's structure and was deeply involved in manuscript draft revisions, particularly the incorporation of a more robust theoretical framework.

Data availability

The data that has been used is confidential.

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